Turbomeca USA
SAFRAN Group

Turbomeca USA, Inc.
Accident Investigation and Safety
2709 Forum Drive
Grand Prairie, TX 75052

27 May 2008

ENGINE MANUFACTURER'S FACTUAL REPORT

ANC08FA053

A. ACCIDENT

Operator:	ERA Helicpters LLC		
Location:	Chickaloon, Alaska		
Date:	15 April 2008		
Time:	0930 Alaska daylight time		
Aircraft:	Eurocopter AS350B2 S/N 3158		
Registration:	N213EH		
Engine:	Arriel 1D1:	S/N 9641	
		Module 1 - Accessory Gearbox	S/N 9646
		Module 2 - Axial Compressor	S/N 2998
		Module 3 - Gas Generator	S/N 9211
		Module 4 - Power Turbine	S/N 9996
		Module 5 – Reduction Gearbox	S/N 9731

B. INVESTIGATOR

Name: Archie Whitten

C. SUMMARY

On April 15, 2008, about 0930 Alaska daylight time, a Eurocopter AS350B2 helicopter, N213EH, sustained substantial damage during an in-fight collision with terrain, about 34 miles east of Chickaloon, Alaska. The helicopter was being operated by ERA Helicopters LLC, Anchorage, Alaska, as a visual flight rules (VFR) passenger flight under Title 14, CFR Part 135, when the accident occurred. The commercial pilot and three passengers received fatal injuries, and one passenger received serious injuries. A mixture of visual and instrument meteorological conditions prevailed in the area of the accident. The helicopter departed Anchorage about 0805, and the company flight following procedures was in effect.

D. DETAILS OF THE INVESTIGATION

An arrival inspection and engine component inventory was conducted in the presence of the NTSB IIC and representatives from the BEA and FAA. The engine front mount was intact with no visible damage. The linking tube was dented (approximately four o'clock position) at the rear mounting point.. The splined shaft of the free wheel shaft exhibited rotational damage at the forward edge of

the splines (the connection to the aircraft transmission shaft).The engine bleed valve was in the open position. The inlet nose cone was intact with no visible damage. Foreign object damage (small nicks) was found on all blades of the axial compressor. Corresponding rub marks were observed on the compressor casing. The axial compressor blade erosion check was 1.5mm. The gas generator was seized. The free turbine had experienced blade shedding. Dents were observed inside the exhaust duct. Free turbine rotation was confirmed, but was difficult due to the damage. The bearing support assembly was twisted and buckled. The containment ring was intact. Two bolts (left side) of the four bolts that attach the MO2 to MO1 were sheared at the MO1 helicoils. The MO2/MO3 had shifted outboard and upward and the 'O ring' at the accessory drive pinion was visible. The accessory drive pinion housing on the MO2 casing was elongated. All engine pipes and hoses (air, fuel, and oil) were secure. No indications of leaks were observed. The engine oil filter by-pass button indicated there had been no by-pass. The electrical magnetic plug at the oil outlet was clean, a small sliver was observed on the electrical magnetic plug of the rear bearing oil return. Both MO1 and MO5 magnetic plugs were contaminated. The oil filter was clean. An oil sample was collected from the MO5 oil sump. Visual external inspection of the fuel control unit (FCU) revealed no anomalies. The FCU was removed from the Accessory Gear Box (MO1), sent to the fuel component department, and installed on the FCU test bench.

According to the FCU log card, the FCU had operated for 2,316 hours since the last overhaul in January 2005. During those 2,316 hours of operation, no discrepancies were reported. The 13 factory-installed tamper-proof lock wire seals were intact. The anticipator coupling and main fuel coupling were rotated through their full range of travel; no discrepancies were noted. The FCU fuel filter was removed and inspected, no anomalies noted. For the test, a new 63 micron 'in line' filter element was installed on the bench. When the FCU was started, a fuel leak was observed at the cap plug of the strainer. The strainer is located on the right side of the intermediate body. It was decided to perform the test without repairing the leak. The FCU was tested in accordance with the functional test procedures and applicable Arriel 1 Engine Repair Manual. The test findings were normal for an FCU in service. There was no indication of abnormal fuel flow or FCU response. The 'in line' filter element was removed after the test; no contamination was noted. Disassembly of the FCU was not required.

The disassembly examination consisted of the removal of the Reduction Gearbox (MO5), removal of the Free Turbine (MO4), and removal and disassembly of the Free Wheel assembly. Removal of the MO5 revealed the top of the module casing had cracked and two pieces of the casing had separated. The muff coupling between MO4 and MO5 was correctly installed according to the inscribed marks. The coupling exhibited flaring and rotational damage at both forward and aft splines. The degree of damage was greater at the forward splines (MO4 side). The index marks on the MO5 input drive gear and lock nut were misaligned in the tightening direction. The misalignment measured 7mm. Rotational continuity of the MO5 gear train was confirmed, rotation was smooth with no binding. Due to the damaged bearing support, removal of MO4 required the use of a plasma torch. The containment ring was intact and had contained the blade shedding. All the turbine blades had separated from the turbine disc at the designed shear point. The power turbine shaft was intact. When the disc was rotated by hand, a scraping noise was noted. The bearing assembly was not disassembled. Removal of the free turbine nozzle guide vane revealed carbonization in the engine rear bearing assembly. The rear bearing was rotated by hand. The labyrinth air seals exhibited rotational damage. Rub marks at the second stage turbine blade path were observed. The free wheel shaft assembly was removed from the engine and disassembled. The splined shaft exhibited rotational damage at the forward edge of the splines (the connection to the aircraft transmission shaft). The free wheel shaft was bent. No dimensional examination was performed. Disassembly of the clutch housing revealed marks on two rollers of the clutch. One mark was observed on the inner race. To repackage the engine for storage, it was necessary to separate the MO2/MO3 from the MO1. When separated rotation of the compressors and gas generator turbines was confirmed, but was difficult with a scraping noise. Rotational continuity of the MO1 gear train was confirmed, rotation was smooth with no binding.

E. CONCLUSION

The engine disassembly revealed that an over torque event occurred, leading to shortening and disconnection of the engine to main gear box transmission shaft. This disconnection (on the engine side) was followed by an over speed of the free turbine that resulted in the designed shedding of the power turbine blades. The damages found on the engine are the consequence of the blade shedding. The internal damage to the engine is consistent with the engine continuing to run after the free turbine blade shedding. Disassembly of the free wheel assembly revealed slight marks on two rollers and on the inner race. These marks are not sufficient to explain a possible "sliding / re-engaging" of the clutch.
The findings on the FCU test bench inspection were normal for a FCU experiencing 2,316 hours of operation since overhaul. There were no indications of abnormal fuel flow or FCU response.

F. PICTURES

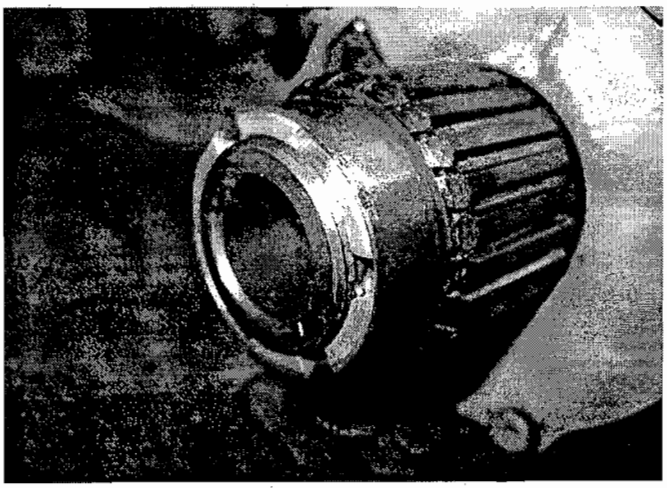

Figure 1: Splined Shaft

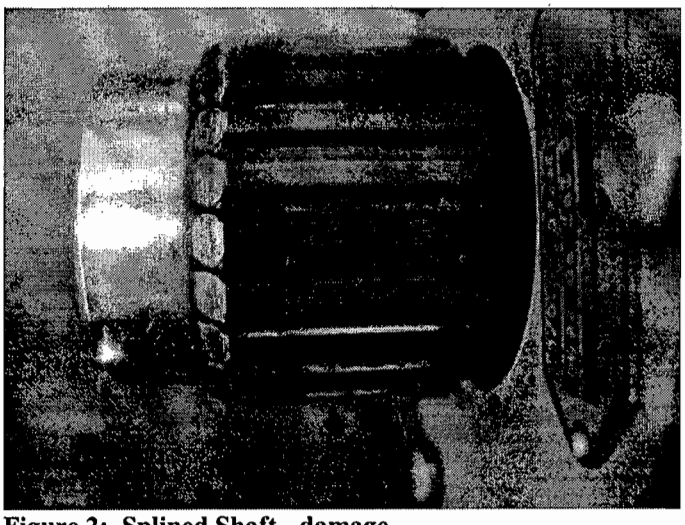

Figure 2: Splined Shaft - damage

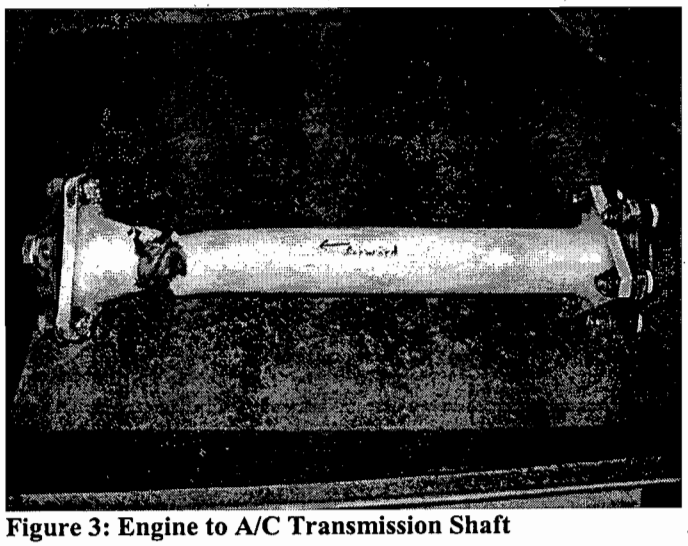

Figure 3: Engine to A/C Transmission Shaft

Figure 4: Shaft – damage

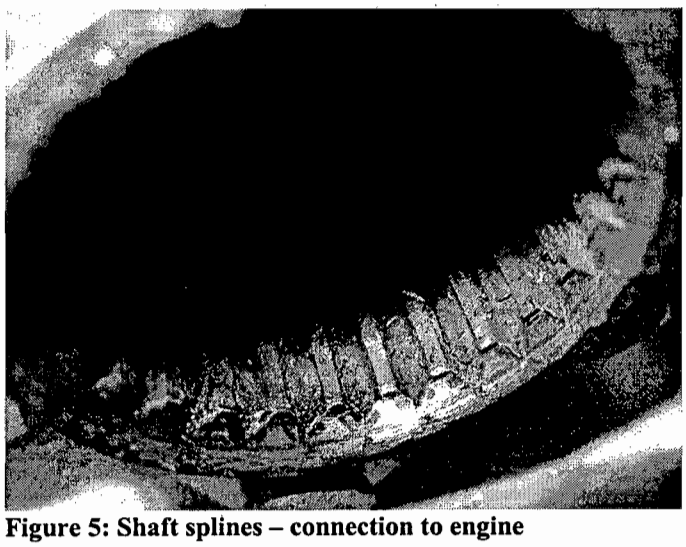

Figure 5: Shaft splines – connection to engine

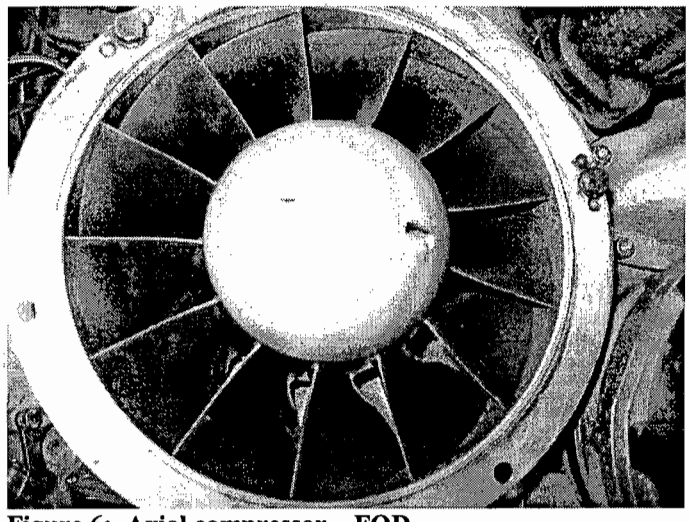

Figure 6: Axial compressor – FOD

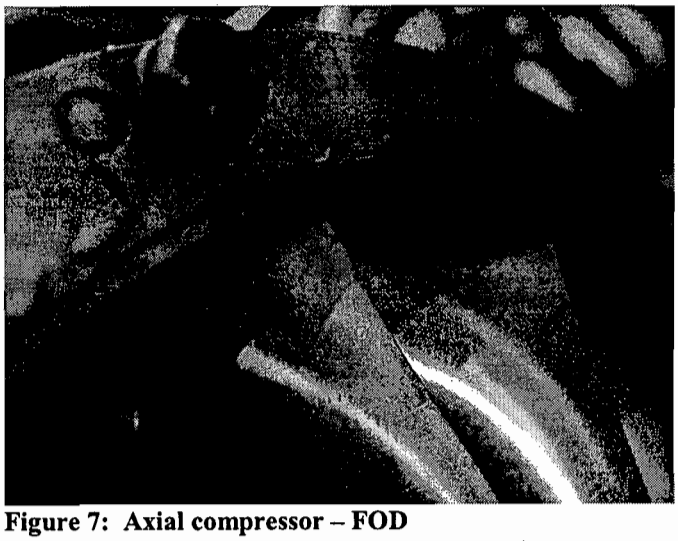

Figure 7: Axial compressor – FOD

Figure 8: MO2 – twisted and separation from MO1

Figure 9: Compressor case – damage

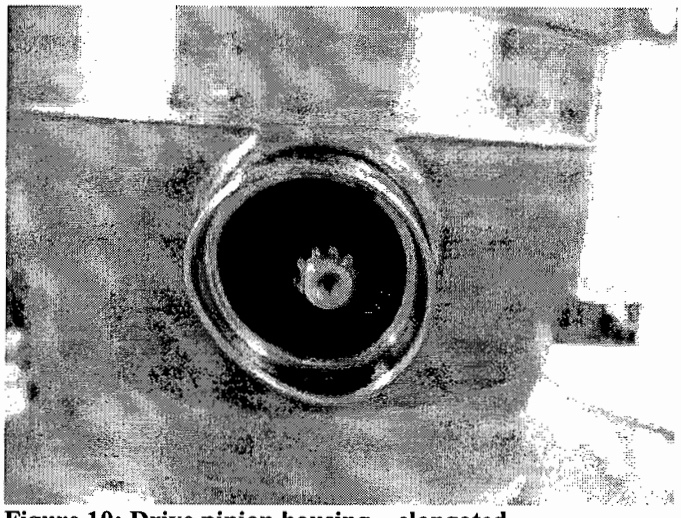

Figure 10: Drive pinion housing – elongated

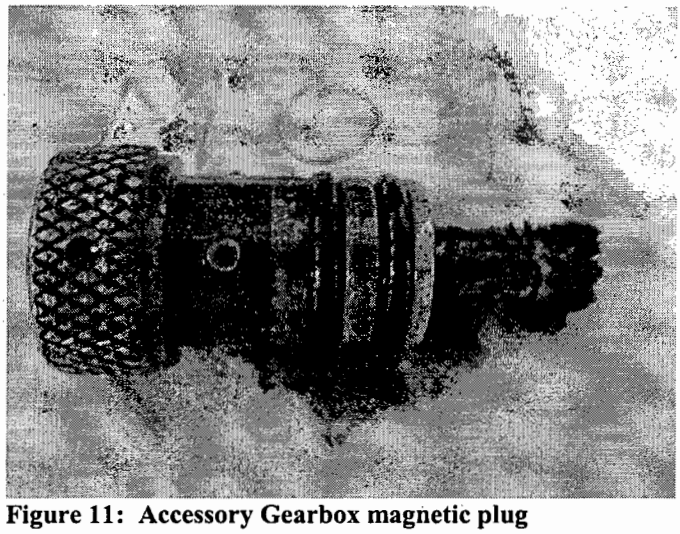

Figure 11: Accessory Gearbox magnetic plug

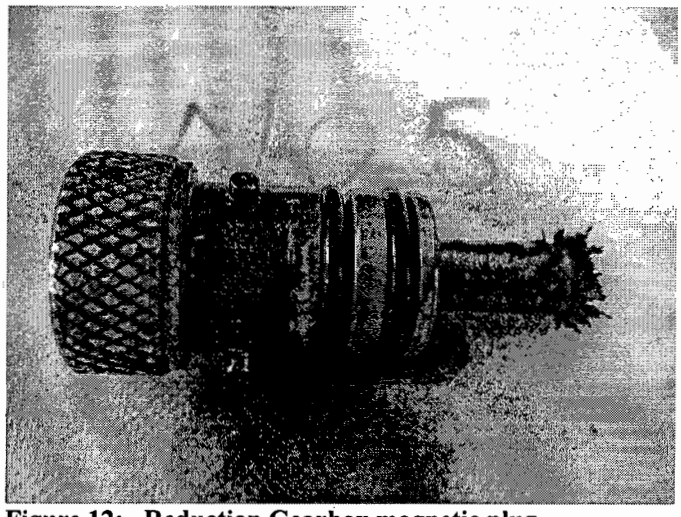

Figure 12: Reduction Gearbox magnetic plug

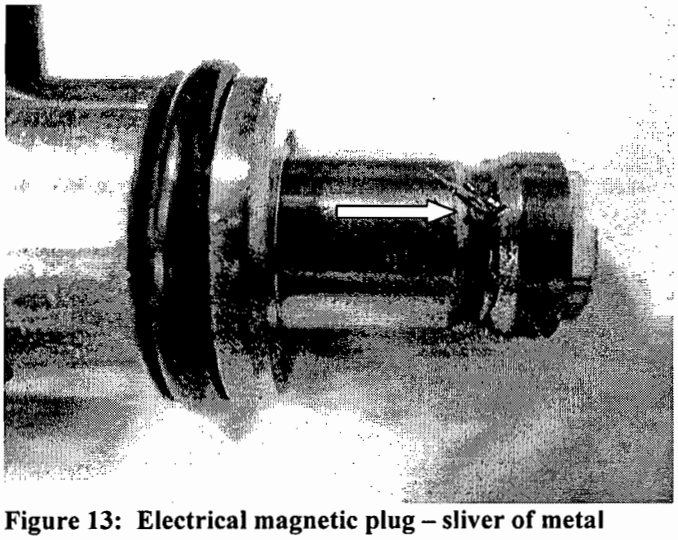

Figure 13: Electrical magnetic plug – sliver of metal

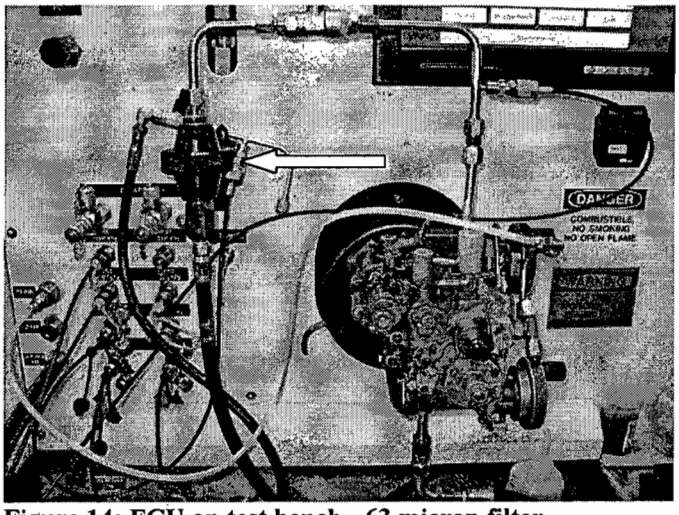

Figure 14: FCU on test bench - 63 micron filter

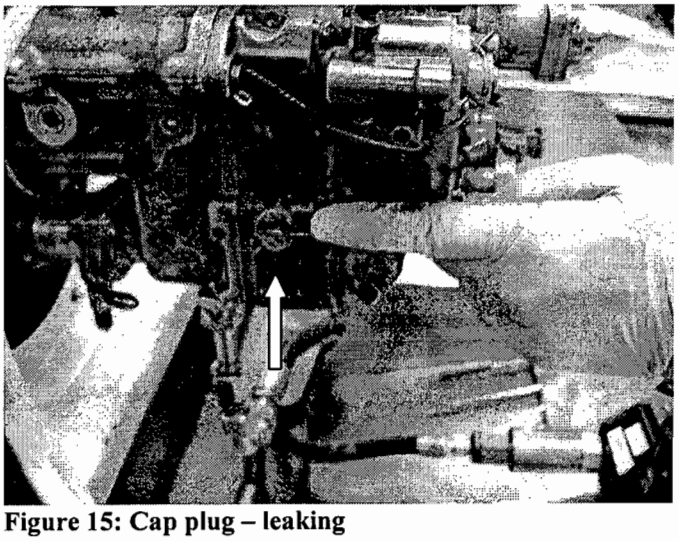

Figure 15: Cap plug – leaking

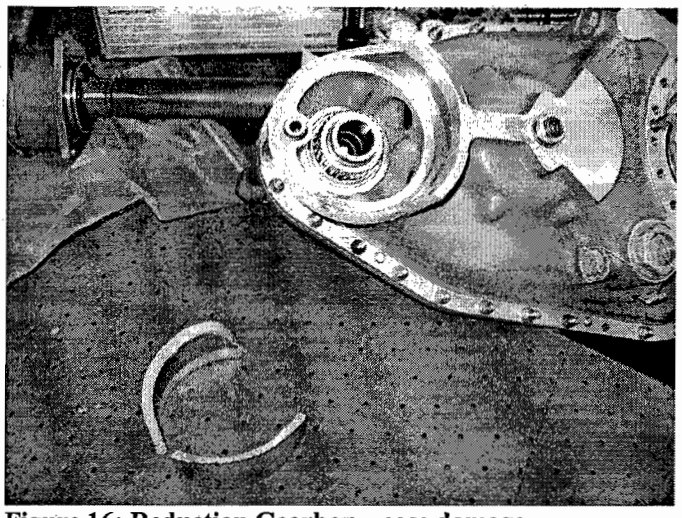

Figure 16: Reduction Gearbox – case damage

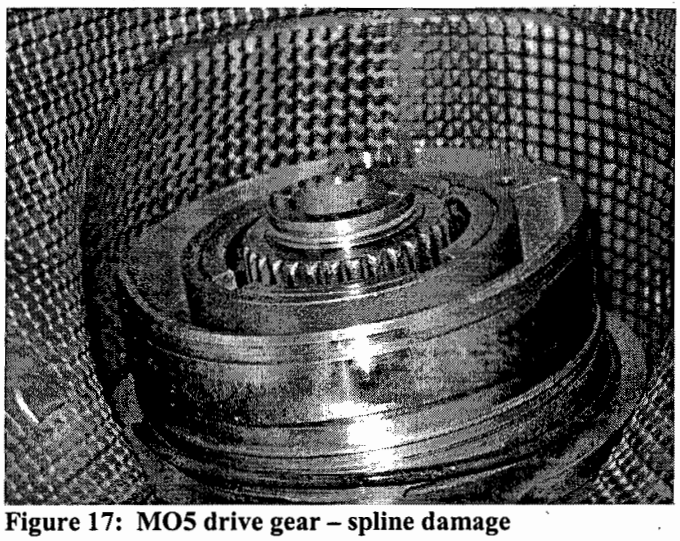

Figure 17: MO5 drive gear – spline damage

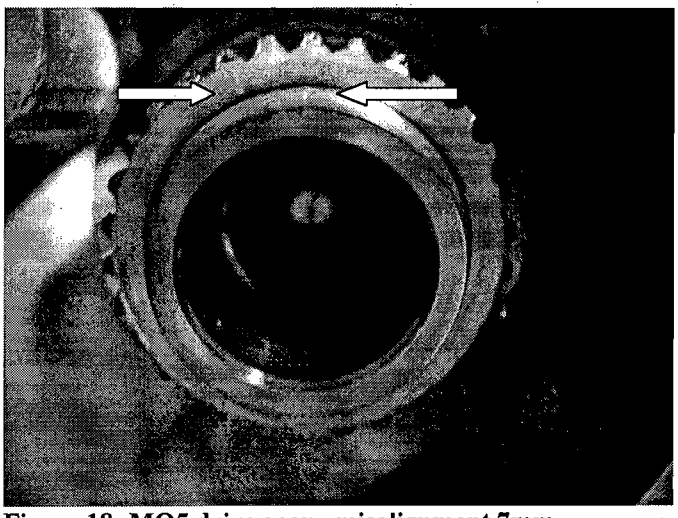

Figure 18: MO5 drive gear - misalignment 7mm

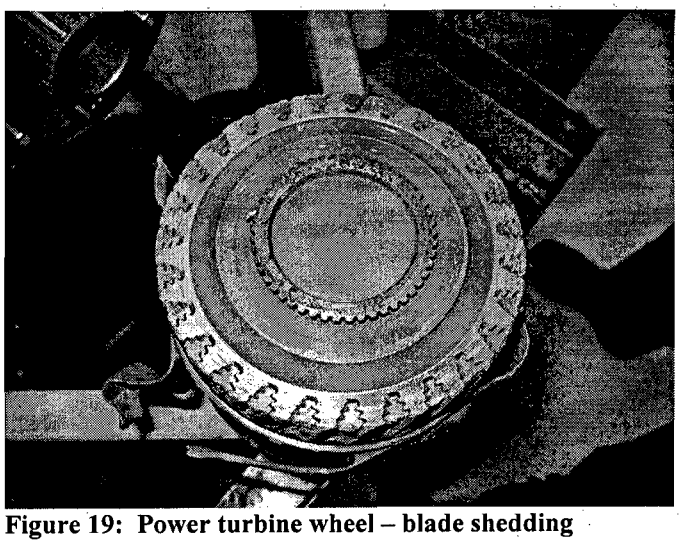

Figure 19: Power turbine wheel – blade shedding

Figure 20: Muff coupling - MO4 side

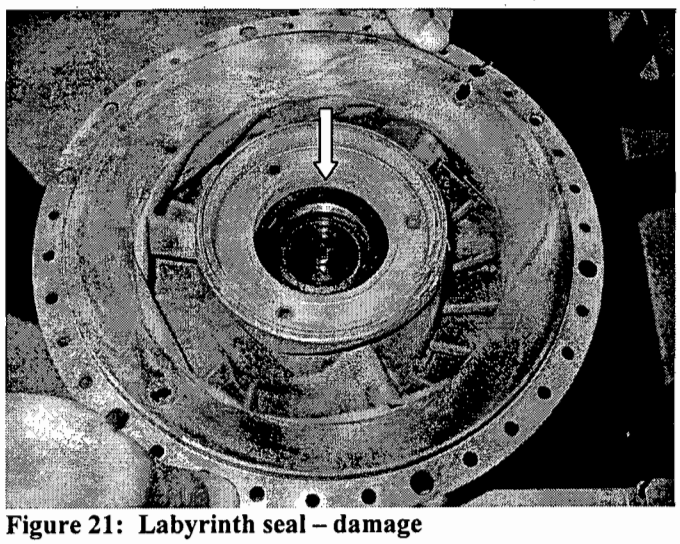

Figure 21: Labyrinth seal – damage

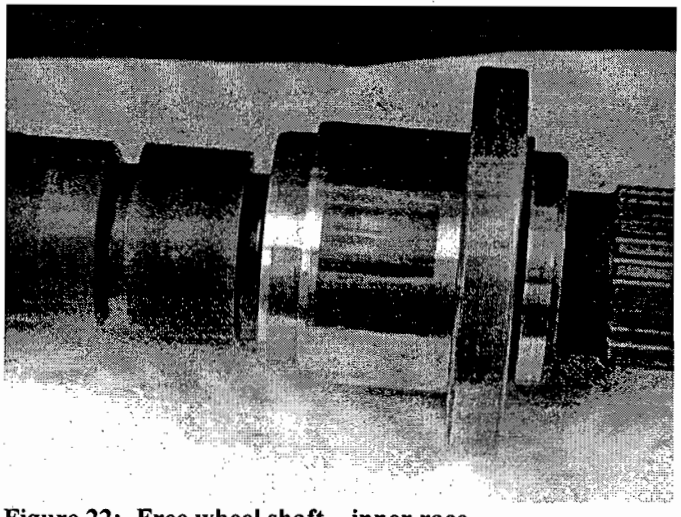

Figure 22: Free wheel shaft – inner race

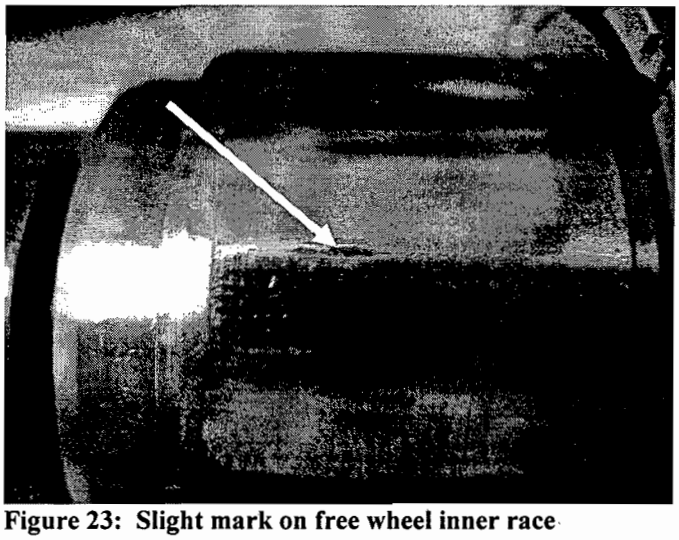

Figure 23: Slight mark on free wheel inner race

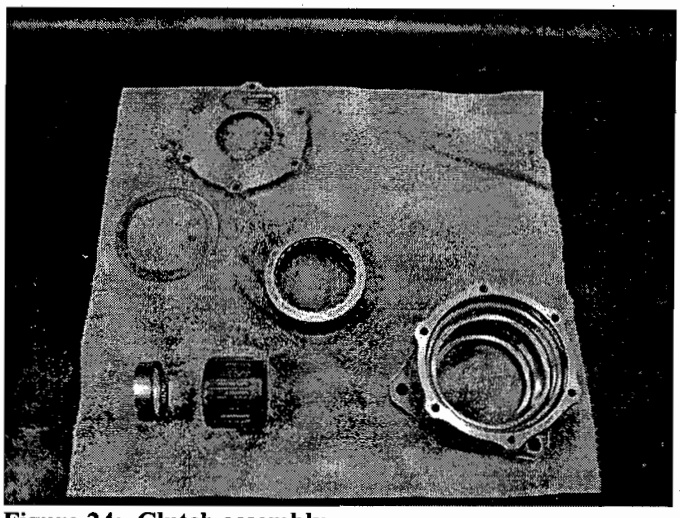

Figure 24: Clutch assembly

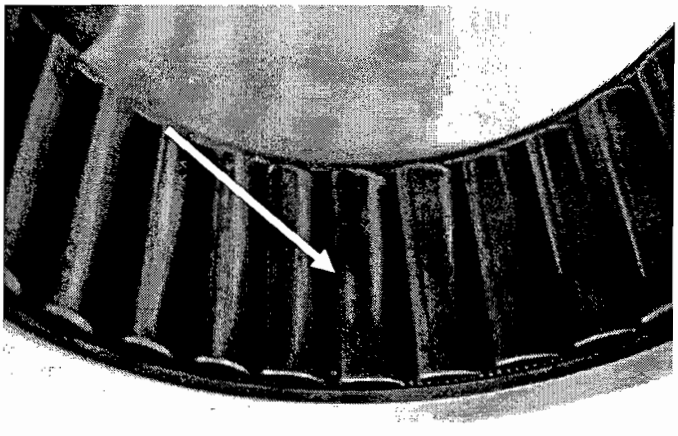

Figure 25: Slight mark on 2 free wheel clutch rollers

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